

Final Exam Study Guide

CSE 30151 Spring 2020

2020/04/28

The final exam will be on May 7, from 10am to 10pm Eastern time. It will be comprehensive, but focusing more on material from after the midterm exam. Here are the instructions from the exam booklet:

- This exam has eight questions, worth 15 points each, for a total of 120 points (20% of your grade).
- Allowed sources
 - You **may** use the textbook, lectures, videos, and lecture notes for this course. Please cite your source only if you need to use a definition or proof and don't want to re-define or re-prove it.
 - You **may not** communicate with any people (inside or outside the class) about any topic related to this exam.
 - You **may** use sources other than the ones listed above. Please cite all sources that contributed substantially to your solution. You **may not** copy or quote from these sources.
- Please post clarification questions as private questions on Piazza.
- Please create a PDF file containing your solutions.
 - You can write your solutions by hand, but please scan them to convert them to PDF.
 - Please don't put any identifying information in the file, so that we can grade the exams blind.
- Please submit your PDF in Sakai under the assignment "FE."

Many of the practice problems below are from the textbook. The numbers are from the 3rd US edition. If the 3rd international edition has a different number, it is indicated by "intl."

The current draft for the exam walks through five classes of languages covered throughout the semester.

Regular languages

1. Regular languages: Prove that a given language is regular (like HW2 1, 2a; HW3 2a, 3a) or that the result of some operation on languages is regular (like HW2 Q3, Sipser 1.31 (intl. 1.36), Sipser 1.66a (intl. 1.60)).

Context-free but not regular

2. Prove that a language is *not* regular, using the pumping lemma, any results proved in the book or in class, or any combination thereof. Like HW3 1b, 2b, 3b; Sipser 1.29ac, 1.46b (intl. 1.51b).
3. Prove that a language is context-free (like HW4 1ab, 3c; Sipser 2.4ad, 2.6ac, 2.7ac) or that the result of some operation on languages is context-free (like HW5 2a, but not as hard; Sipser 2.38 (intl. 2.50), but not as hard).

Polynomial time but not context-free

4. Prove that a language is *not* context free, using the pumping lemma, any results proved in the book or in class, or any combination thereof. Like HW5 1, 2b, 3; Sipser 2.30bc (intl. 2.42bc).
5. Prove that a language, or the result of some operation on languages, is in P.

Undecidable languages

6. Prove that a language is undecidable by reduction from another undecidable language (like CP3 Q3, HW7 Q1a, Q3a).

NP-complete languages

7. Prove that a language is NP-complete by reduction from all NP languages (like HW8 Q3).
8. Prove that a language is NP-complete by reduction from another NP-complete language (like CP4 Q3, HW8 Q1–2).

Topics *not* covered

- Conversion between DFAs, NFAs, and regular expressions
- Conversion between CFGs and PDAs
- Chomsky normal form (108–110)
- Deterministic context-free languages (Sipser, 2.4)
- Proving undecidability by diagonalization (Sipser, pages 202–209)
- Examples of decidable languages (4.1) and polynomial languages (7.2). Actually, the exam does refer to Theorem 7.16, but you do not need to understand anything about it other than the statement.
- Advanced topics in computability theory (Sipser, Chapter 6)
- Sipser, Chapters 8 and beyond